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ABSTRACT

This study is one of a series of studies conducted or planned by the authors investigating the information processing strategies employed by students who are placed in a quasi-instructional setting of learning from text with questions interspersed. The subjects were 65 undergraduate students from two introductory educational psychology courses. Three factors were investigated: questioning procedure, instructions, and scales. Two question positions were investigated: (1) subjects answered questions just before relevant text portions, and (2) subjects answered those same questions after reading the relevant text portions. Instructions to subjects were of two types: Part, which indicated that the inserted questions were only a part of the questions which would appear on the criterion test, and Total, in which subjects were instructed that the inserted questions represented the total information they were expected to learn. Some of the results indicated: no differences were observed on practiced items; Dunnett's test revealed that the control group exceeded the experimental group on non-practiced items; and the control group was fastest on practice retention. (Author/WR)

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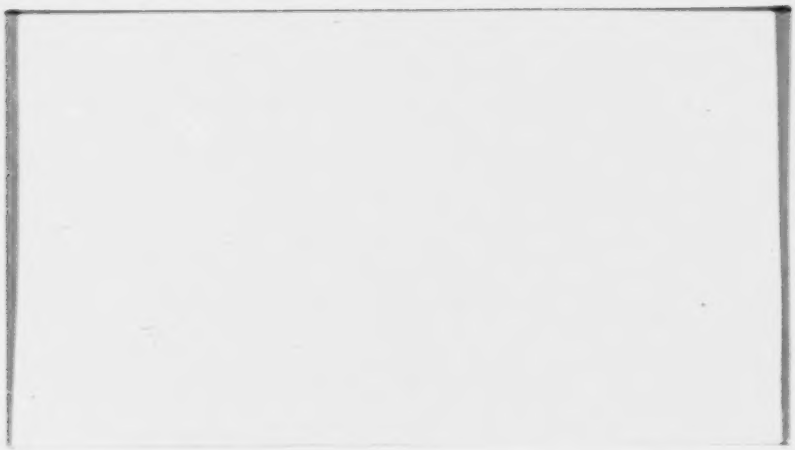

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Recall Instructions and Learning from Text with Adjunct Questions

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Recall Instructions and Learning from Text with Adjunct Questions

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This study is one of a series of studies conducted or planned by the authors investigating the information processing strategies employed by students who are placed in a quasi-instructional setting of learning from text with questions interspersed. Most of the research on this topic has been conducted under the ruberic of mathemagenics (See Rothkopf, 1970). Generally, these experiments have shown that questions inserted in text have increased retention of material directly covered by the interspersed questions (practiced items) as compared to unquestioned controls. Further, it has been shown that questions inserted after text segments to which the question is relevant can facilitate retention of material not directly tested by the interspersed questions (non-practiced items) as compared to questions before or no questions (See Frase, 1970 for a review).

Carver (in press) has criticized these studies on several grounds, one being a failure to adequately control or account for subject strategies in dealing with the text and adjunct questions. Specifically these studies have left S uninstructed concerning the nature of the criterion test and the exact relationship between criterion test items and interspersed questions. Carver has argued that the ambiguous nature of instructions to Ss concerning these matters could seriously influence the observed effects of question position and cast doubt

upon the interpretations that Rothkopf and others have given to their results.

Processing strategies employed by learners have also been examined by Keller and Cunningham (1972). These authors proposed an information search model of learning from text with questions interpersed in which S's search strategies were presumed to be under rather direct control of environmental constraints, such as instructions. In treatments where questions precede text segments (QB), Ss were presumed to enter the question into memory and rehearse it so that it would be available in memory when S turns to the text and begins reading. Reading was viewed as an information search activity where the reader scans for information pertinent to the question. Material not deemed pertinent will receive less processing and, therefore, not be as well retained as the pertinent material. In treatments where questions follow text segments (QA) S was characterized as reading the material, trying to incorporate as much of it as he could so that it would be available in memory when the question is encountered. When S does encounter the question he retrieves the pertinent information and transforms it to meet the demands of the question. This further processing of the pertinent material makes it more memorable than other information in the passage.

The present experiment represents an attempt to investigate the influence of directions to S concerning the relation between the criterion test and the adjunct questions. If Carver (1970) is correct that some Ss are interpreting the somewhat ambigious instructions used

in prior questioning studies in different ways and that different interpretations will lead to differential search strategies on the part of Ss, then it should be possible to predict consequences of various strategies. Specifically, we believed that telling Ss that they would be tested only on the content tested by the adjunct questions would increase the advantage of QA groups on non-practiced material since the QB group could (if they were so inclined) narrow their concentration to a great extent to the practiced content. The QA group cannot, of course, narrow their search behavior since they are uncertain as to which content will be tested. Thus, if S strategies are under control of instructions, an interaction between question position (before or after), instructions, and retention (practiced or non-practiced) should be observed. The present study was undertaken to investigate this possibility.

Method

Materials

The materials selected were those previously used by Frase (1968) and adapted accordingly for this experiment. The material consisted of a continuous prose passage of biographical material about William James from Psychology: The Science of Mental Life, by Miller (1962).[1] The material was divided into twenty paragraphs, each paragraph on a separate sheet of 5 x 8½-inch paper. The Frase materials provided two multiple-choice questions (five alternatives) from each paragraph which required the recall of specific factual information from that paragraph. The two questions were constructed so as not to overlap

[1]Permission for using these materials kindly granted by Harper & Row, Inc.

in content. Twenty questions were used as practiced (P) questions on the post-test. These questions were inserted during the learning session for those groups which received before or after questions. The other set of twenty questions was used to test non-practiced (NP) learning. The forty-item criterion test was mimeographed on five 8½ x 11 sheets of paper. Twenty practiced and twenty non-practiced questions were randomly interspersed thoughout the test.

Subjects

The Ss were sixty-five undergraduate students from two introductory educational psychology courses at Indiana University. Participation in the experimental study was a course requirement. Subjects were run in their classrooms with assignment to treatment randomized within class with the restriction of equal cell sizes.

Design and Procedures

Three factors were investigated in this experiment: Questioning procedure, Instructions, and Scales. Two question positions were investigated: (1) QB in which Ss answered questions just before relevant text portions, and (2) QA in which Ss answered those same questions after reading the relevant text portions. Instructions to Ss were of two types: Part which indicated to Ss that the inserted questions were only a part or subset of the questions which would appear on the criterion test; and Total in which Ss were instructed that the inserted questions represented the total information they were expected to learn. The Scales factor was a repeated measure: P test items versus NP items. Two question procedures and two instructional sets

produce four treatment conditions (n = 13 in each). A control group (n = 13) was also run which had no interspersed question and who were simply told they would be tested on the content of the passage. Each S worked through the text at his own rate but was not permitted to review the text. Immediately upon completing the text all treatment groups and the control were administered the forty item criterion test. In addition, Ss were asked to record starting and finishing times on the materials.

rats?

Results and Discussion

To examine the relationships between the four treatments and the control groups, two one way analyses of variance were conducted, one using P items, the other NP items as the dependent measure. No differences were observed on practiced items while on non-practiced items, Dunnett's test revealed that the control group exceeded the SB-Total group ($p < .05$) and nearly exceeded the SB-Part group ($.05 < p < .06$).

A separate analysis was conducted with the five groups using time to complete the text materials as the dependent measure. On P retention, the control group was fastest, as expected since they answered no questions but there were no treatment group differences. On NP retention, the control group was significantly faster ($p < .05$ using Dunnett's test) than the two groups with questions before. No other differences were significant.

The treatment effects of major interest were analyzed by a three factor (2 x 2 x 2) repeated measure analysis of variance as implied in the design section above. The analysis showed a significant main effect

for Scales ($p < .01$) indicating that the retention of P items was higher than retention of NP items for all treatment groups. The only other significant ($p < .01$) source of variance was the interaction between Scales and Question position, a finding which confirms previous question position studies. SB and SA groups did not differ on P item retention but the SA group was better than the SB group on NP items.

Apparently the question position phenomenon is robust with respect to the manipulations of instructional sets employed in this study. Either the information search model is not a viable one or for one reason or another the instructions failed to modify mathemagenic processes in any substantial manner.

One reason which occured to us why instructions do not have a stronger effect on the QB - QA difference for NP retention is that Ss in the QB groups still have to read NP material in order to determine its pertinence for answering the adjunct question. Such an hypothesis would imply that retention of NP materials which follow P material in the text should show greater QB -QA differences than the opposite situation. Fortunately the experimental materials were constructed so that half of the time the P content appeared early in the passage, late in the others. The data were reanalyzed adding as a repeated measure the factor labeled Order which referred to whether the P material preceded or followed the NP material. We expected and found no main effects or interactions for Question position, Instructions, or Order on P retention. On NP retention, we expected NP content which followed

P content to be less well recalled than NP content which preceded P content since in the latter situation the NP material would still have to be read and determined as pertinent or not to the adjunct question. That was in fact the case ($F_{1,48} = 28.61$; $p < .01$). It was further expected that the question position effect would be strongest when NP material followed the P material and especially when instructions to S were that only the adjunct questions would reappear in the criterion test. The necessary triple order interaction was in fact significant ($F_{1,48} = 5.65$; $p < .05$) but the relation was not as expected. Figure 1 shows this interaction. The question position difference remains stable on order 1 (NP second) and order 2 (NP first) for "Part" instructions. But with a "Total" instructional set the advantage for the QA group is greatest when the NP material is first in the passage, a finding directly contradictory to that predicted by the information search model.

Insert Figure 1 About Here

Frase (1968) has also examined content location in these same materials and found results contradictory to ours. He found that higher NP retention was achieved if the NP material followed the P material, regardless of question location. To further evaluate the reliability of our finding, a reanalysis of an earlier study using the same materials (Keller and Cunningham, 1972) was made. That reanalysis showed that once again NP retention was higher when it

preceded P. content than when it followed. A possible reason for the discrepancy between Frase's (1968) results and ours is that he used a between subjects design while we used a within subjects design. The Ss in Frase's study could come to rely upon NP or P content being located in specific portions of the passage and adjust their reading strategies to search immediately for the P content. Ss in QB groups in Frase's study were apparently more likely to continue reading after locating P content than were our Ss although Fig. 1 shows no decline in retention of NP materials for the QB group under "Total" instructions.

An interesting outcome of reanalyzing the Keller and Cunningham (1972) experiment is that it allows us to compare the performance of Ss who were left uninstructed concerning the relationship between adjunct questions and the criterion test with those given "Part" and "Total" instructions in the present experiment. Figure 2 shows the interaction between Question position and Order from Keller and Cunningham (1972) and the similarity between this interaction and that for Ss under "Total" instructions in this experiment is clear. Apparently, although this hypothesis needs test, Ss in prior question position studies were operating as if the adjunct questions were the only questions which would appear on the criterion test.

Insert Figure 2 About Here

A tentative explanation for the data shown in Fig. 1 and Fig. 2 might be as follows. When NP information is first in the passage,

it is better remembered than when it is second (when it follows P content) for reasons elaborated above. When QB Ss are given "Total" instructions, however, NP material which appears first is not remembered better than NP material which appears later. All information other than P information is apparently regarded as irrelcvant and treated equivalently. The search for pertinent content is not systematic and orderly, proceding from the first sentence, to the second, and so forth. The S is just as likely to start in the middle or the end of the passage as in the beginning. Since many of the questions were of a specific, factual nature requiring a number, date, or name which could be easily spotted in a cursory search, it is not unlikely that these Ss were selectively attending to a much greater extent than any other. The fact that they completed reading more quickly than any other group lends some support to this interpretation. Such a "selective" strategy is incompatable with the demands placed upon any other treatment group; that is, learning outcomes as described by the instructions could not be maximimzed by using this strategy in any other of the groups. Ss will generally employ that strategy which will maximize learning outcomes but which is also the least effortful, a phenonmenon Rothkopf (1970) has labeled as the "law of least effort." This "law" is one of the basic assumptions of the information search model.

We had expected much stronger effects from the manipulation of instructional sets employed in this study. Keller and Cunningham (1972) also failed to show strong differences in mathemagenic processing as a function of environmental constraints, and an explanation offered

by Keller and Cunningham (1972) is probably relevant here as well--S motivation. Motivation appeared to be relatively high in our Ss and the relatively brief experimental treatment probably was not perceived by many Ss as an imposition. As Frase, Patrick and Schumer (1970) have shown, mathemagenic behaviors are relatively impervious to manipulation at high motivation levels. The same hypotheses tested by Keller and Cunningham (1972) and in the present study should certainly be tested at different incentive or arousal levels.

It is also clear that the information search model of mathemagenic processes needs revision and elaboration. The inclusion of motivational variables is one such possibility. Also in need of revision is the notion that the information search is always entirely orderly and in accordance with a particular sequence. Nevertheless, it does appear that hypothetical S strategies do have some predictive power and should provide some important insights into the process of learning by reading.

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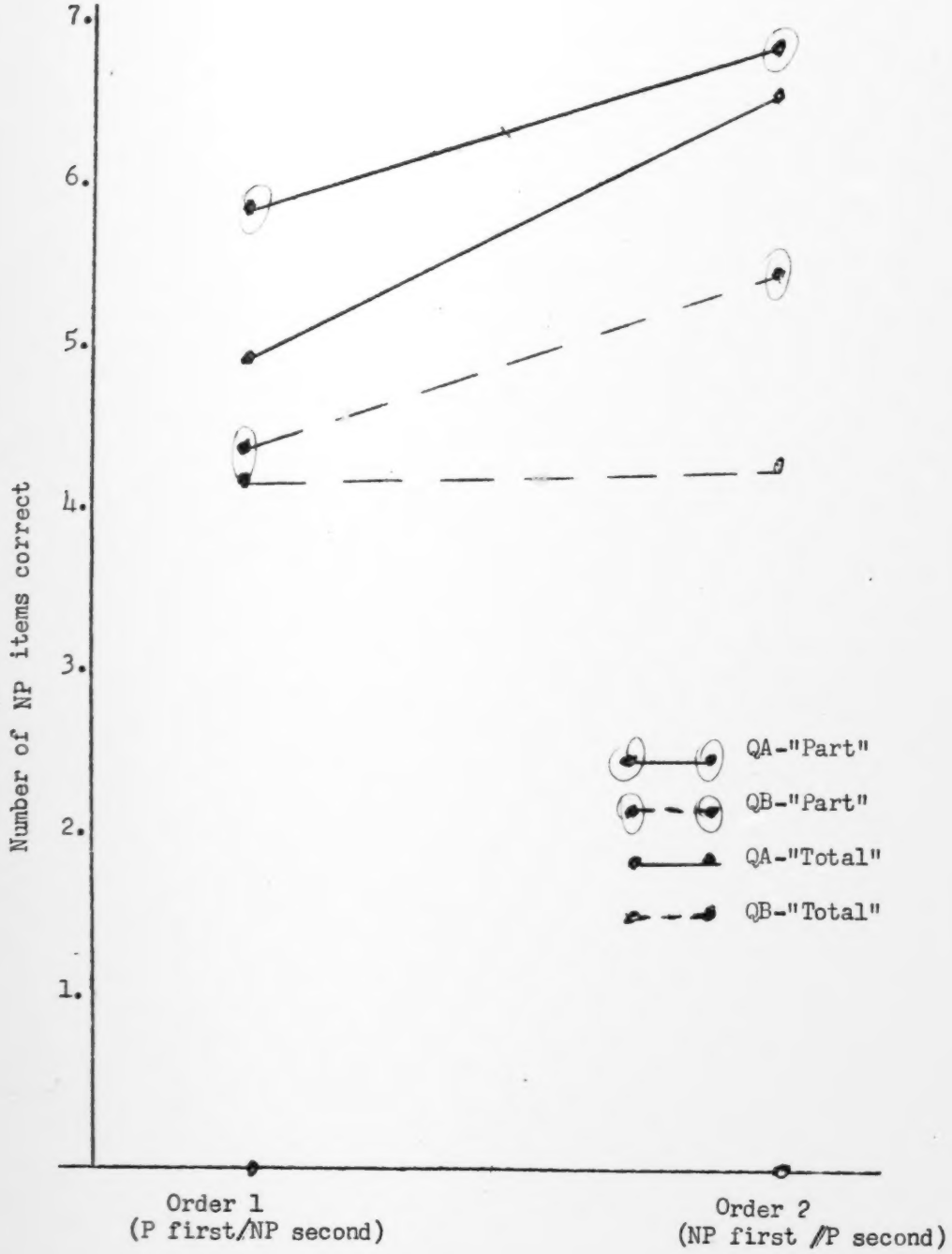

Fig. 1. Significant interaction between Question position, Instructions, and Order

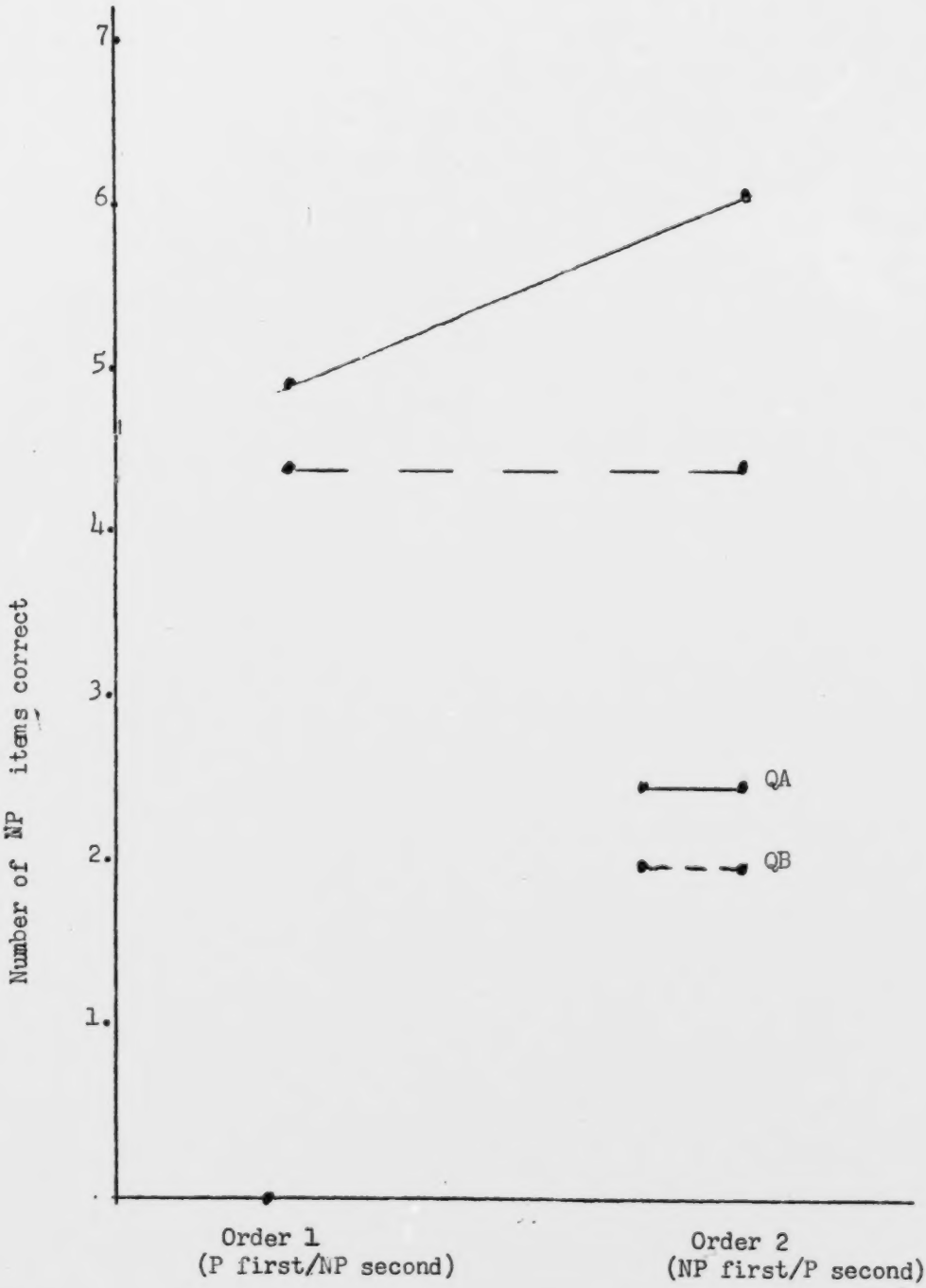

Fig. 2. Significant interaction between Question position and Order from Keller and Cunningham (1972)